

J98Q.1—Parity Violation

Problem

A spin $\frac{1}{2}$ particle of mass m moves in a spherical harmonic oscillator potential and is also subject to a parity violating perturbation. The Hamiltonian is $H = H_0 + H_1$, with

$$H_0 = \frac{p^2}{2m} + \frac{1}{2}m\omega^2 r^2 \quad \text{and} \quad H_1 = \lambda \vec{\sigma} \cdot \vec{r},$$

where σ_x, σ_y , and σ_z are the Pauli spin matrices.

As a measure of the parity violation, compute the expectation value $\langle z \sigma_z \rangle$ for the ground state, to first order in λ .